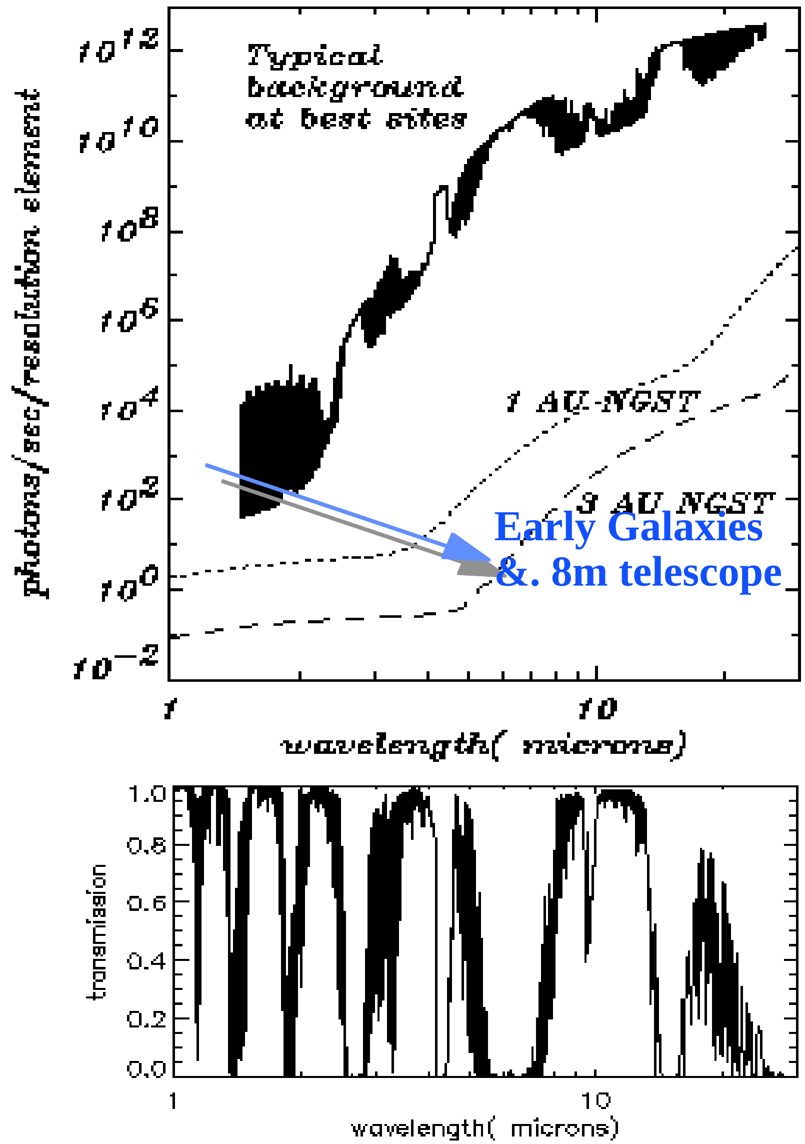
The *HST&B* Science Mission

- The Early Universe:The First Stars and Galaxies
- Geometry and Chemical Evolution of the Universe: Distant Supernovae
- A broad Origins-related program
  - The Evolution of Galactic Structure (the Birth of the Milky Way)
  - Understanding Baryonic Dark Matter (Brown Dwarfs, Grav. Arcs)
  - Evolution of Stellar Populations in and beyond the Milky Way
  - An Ecliptic Plane mini-survey for Kuiper Belt Objects in NIR
- Following *ISO, SIRTF, SOFIA*, Keck, Gemini with the Thermal IR Option
  - Coronagraphic capabilities in TIR for "Jupiter" searches out to 10 pc.
  - Imaging & spectroscopy of distant, embedded AGN and star-forming regions.
  - Solar system composition studies of outer planets, comets, asteroids

HST&B Science Rationale Why?

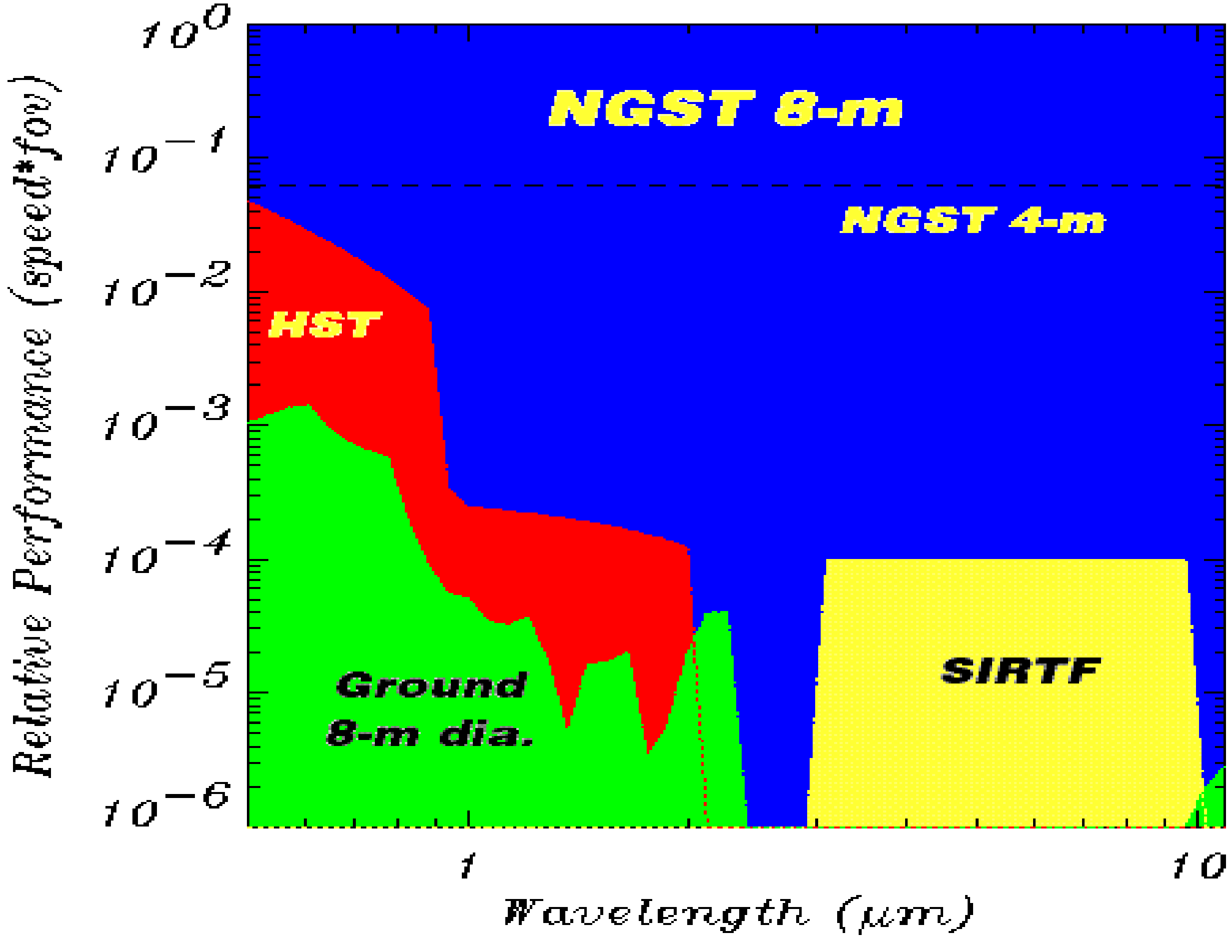
Science with NGST
GSFC, 7 April 1997

- >4m, telescope is required to get the sensitivity required to probe the origins of stars and galaxies at large redshifts (early days).
- A cooled telescope provides 10^2 to 10^8 lower background and perfect transparency. Cooling to deep space breaks the IRAS/ISO "telescope-in-a-bottle" paradigm and permits larger apertures with no additional weight penalty.

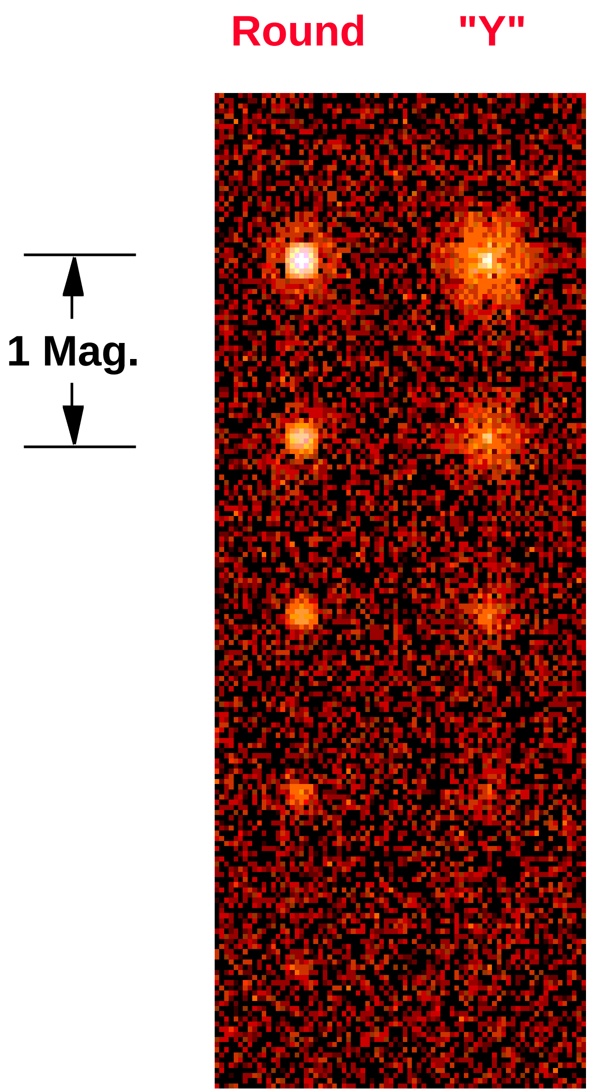


Science with NGST
GSFC, 7 April 1997

An 8 m NGST Provides > 10^3 Speed Improvement from 1-10 µm



Aperture Shape affects Sensitivity



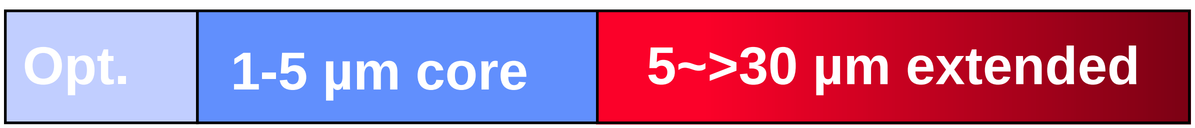
- Filled apertures have higher sensitivity to point sources -- speed approximately ~ filling factor.
- Chart shows stars on noisy background for
  - filled 8 m round aperture
  - 3 8x2 m apertures in a "Y" formation.

  (equivalent area)

Science "Floor" vs "Stretch"

- Science "Floor" mission is >4m dia., NIR imaging and spectroscopy alone. 1 AU orbit
- Science "Stretch" mission is >~8m dia, 5-->30µm, and other instruments if cost impact not too high.

Needs 0.05" imaging
Needs ~30K passive cooling for detectors

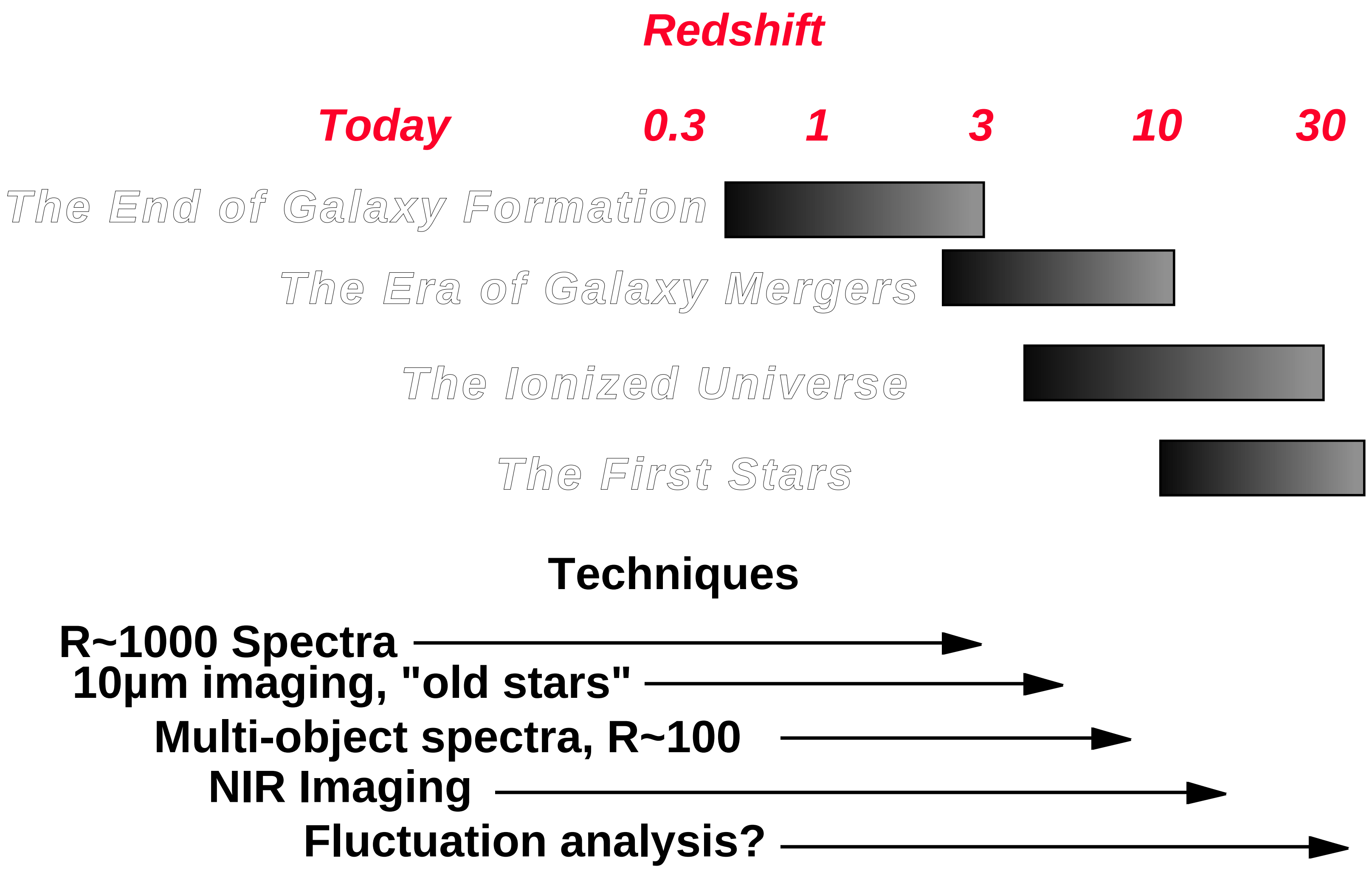


• Will use available mirror quality & detector

• Needs extra cooling for Si:B or HgCdTe
• Instruments may be added by collaborations

Science with NGST
GSFC, 7 April 1997

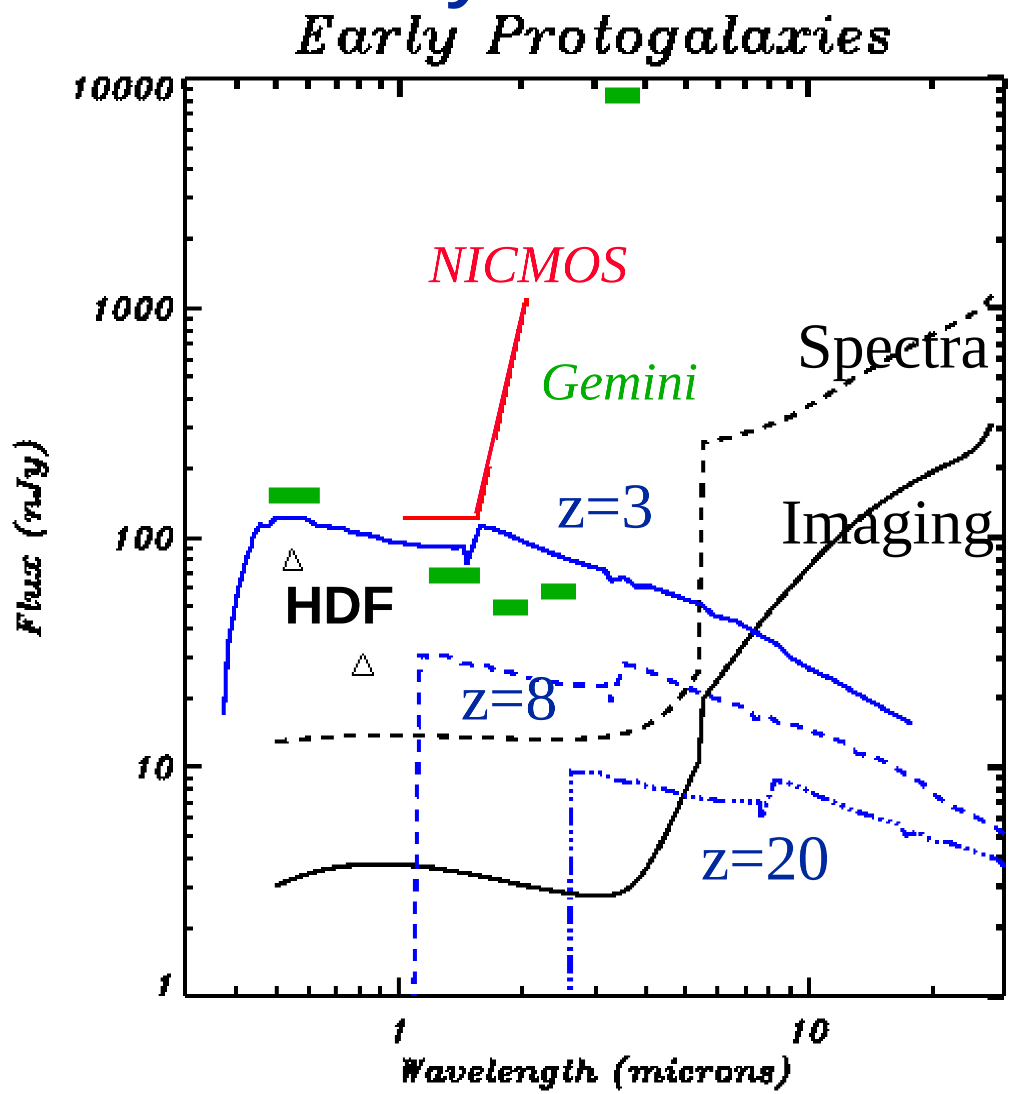
A Science Strategy



PS/ST ScI

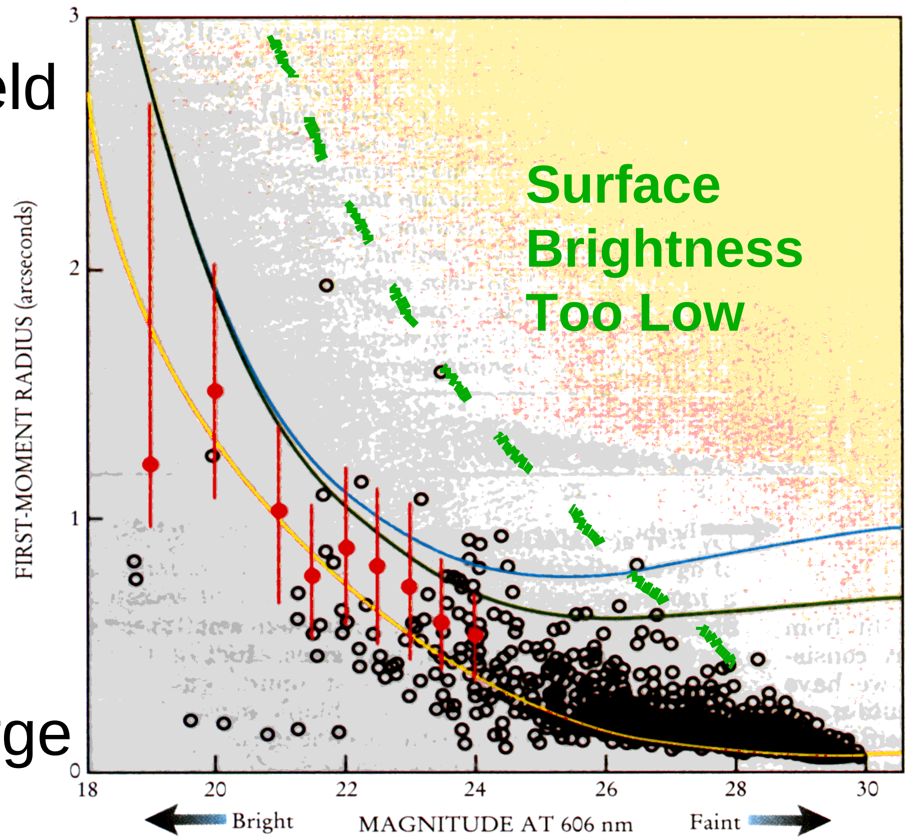
Star formation in the Early Universe

- 3 nJy sensitivities in imaging (10σ in 10^4s)for 0.06 sq arcsec.
- ~10 nJy sensitivities in low res., multi-object spectroscopy
- 1 M_{sol} yr^{-1}
- 25 Myr
- • Ω = 1



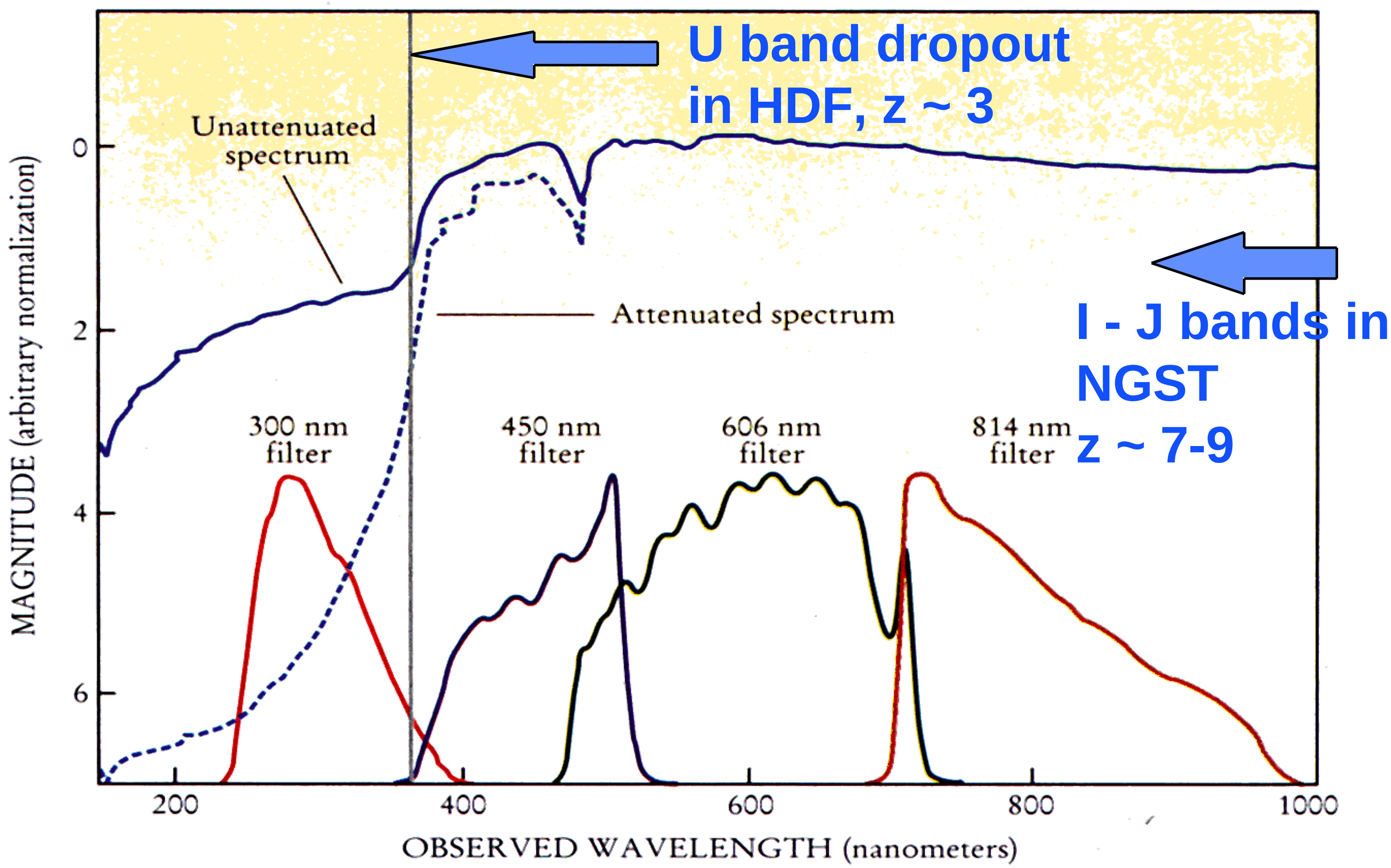
Resolution is important

- The Hubble Deep Field images show that distant objects are *small!*
- Typical size ~ 0.1 arcsec.
- Surface brightness selection does not explain the lack of large galaxies at relatively bright mags.



Typical size ~0.2" at R ~ 28

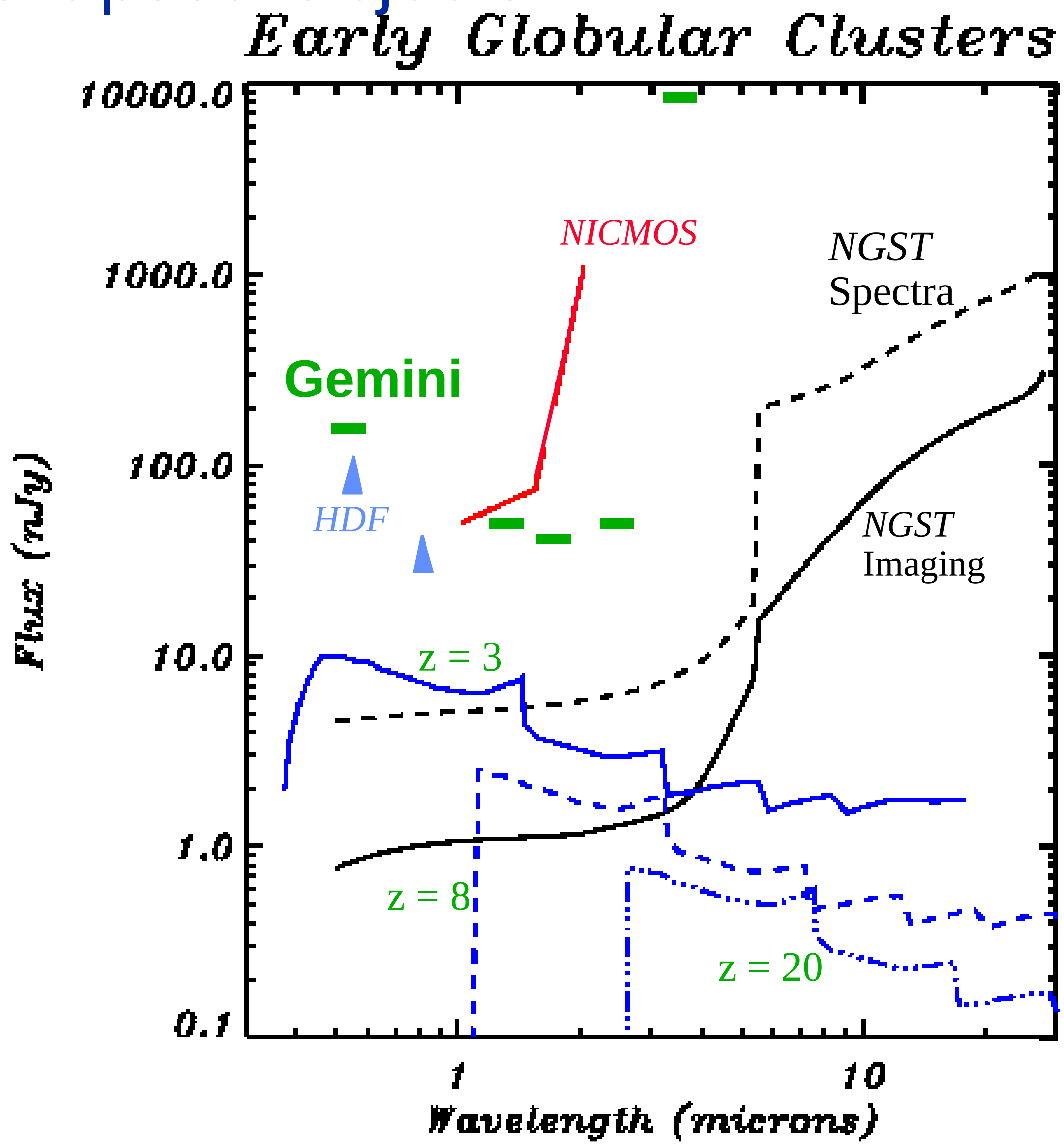
NGST will use "drop-outs" to find high-z objects



Earliest Jeans Mass, Collapsed Objects

Science with NGST
GSFC, 7 April 1997

- Globular Cluster is:
  - 10^6 M_{sol} burst, 1Myr old (Leitherer et al)
- *HST* & Gemini telescopes cannot reach redshifts z > 1-2.
- *NGST* can observe GC formation to z~ 30.



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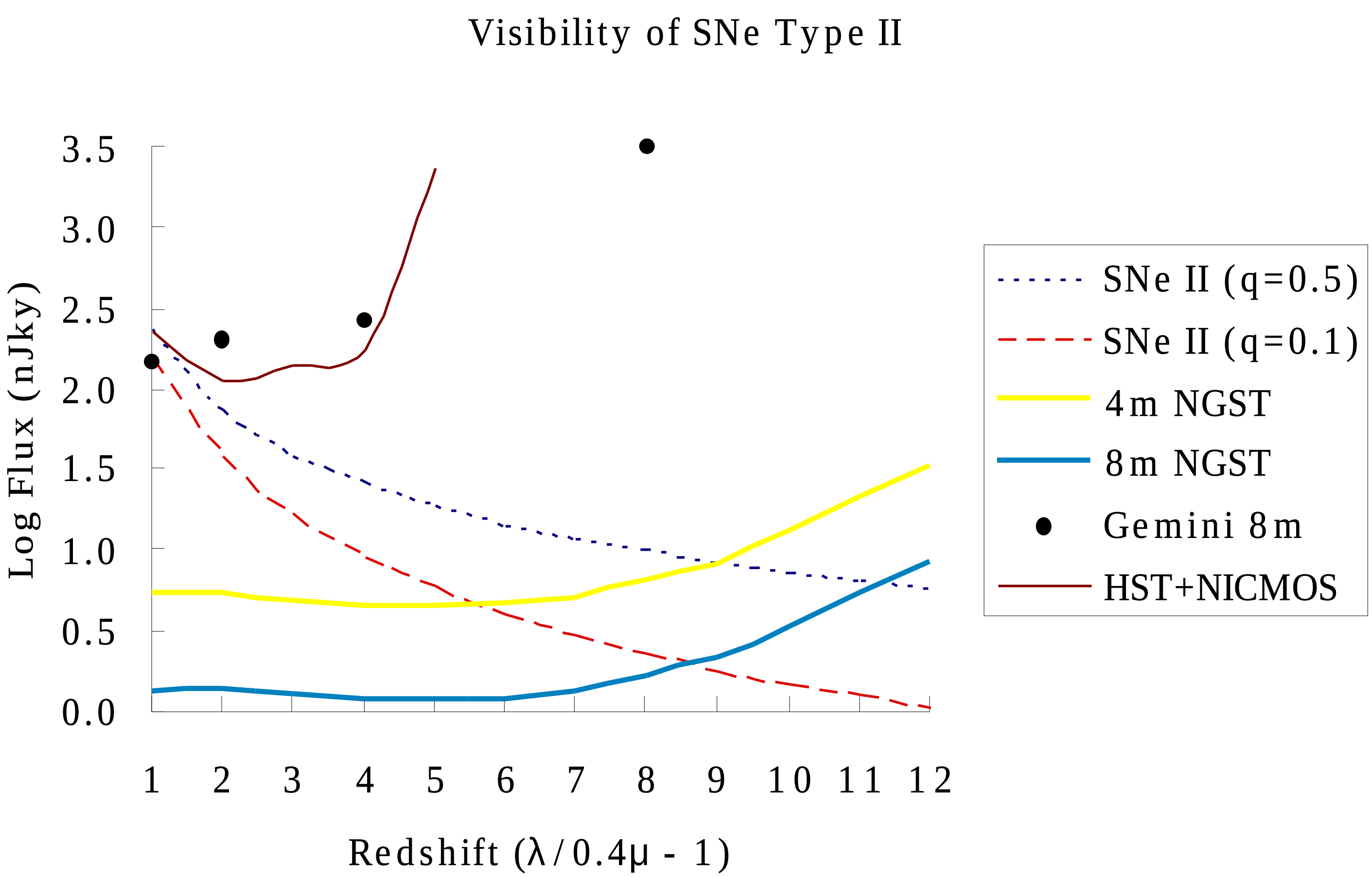
NGST can observe SNe to z >10



Science with NGST
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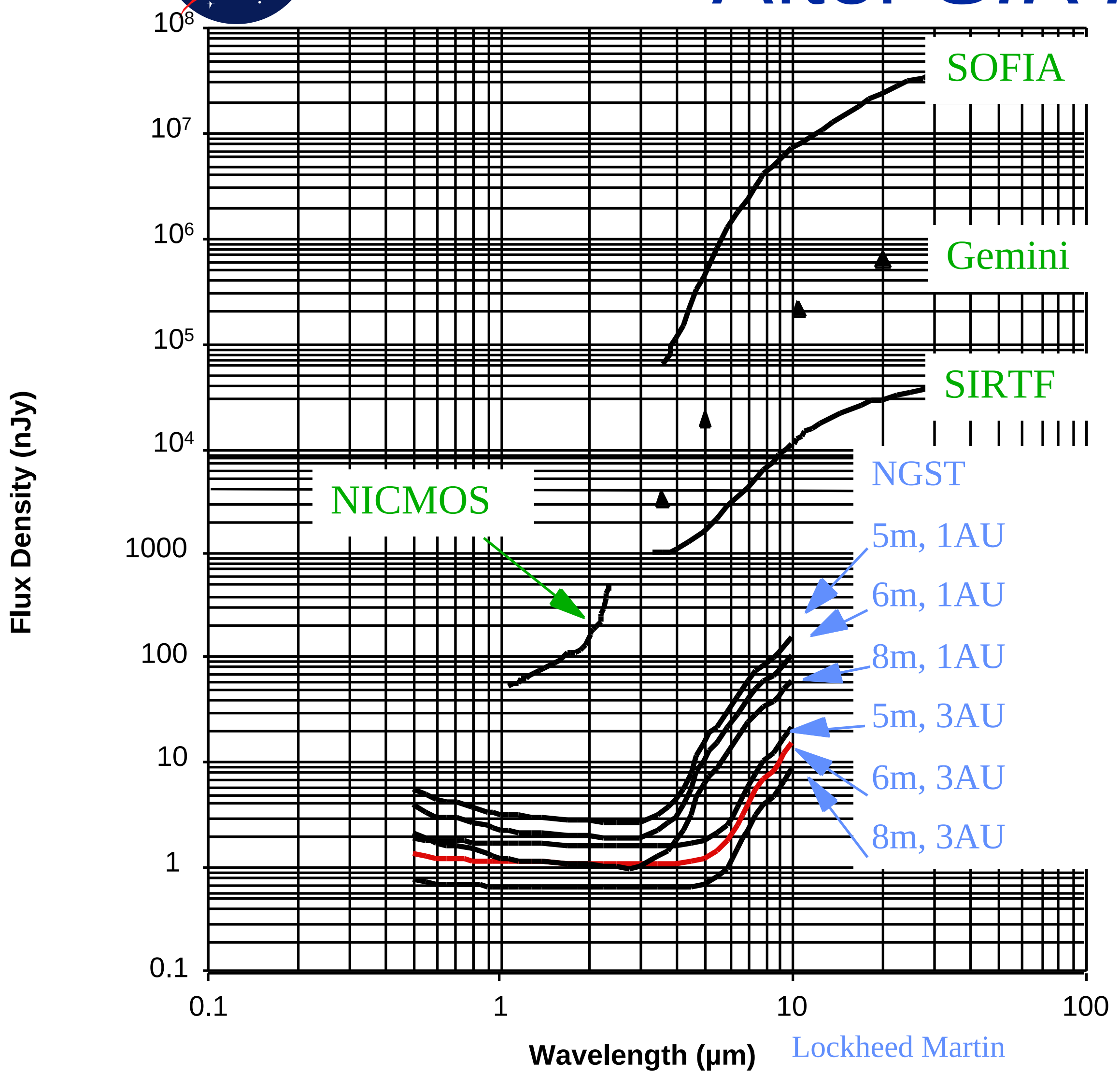
After *SIRTF*

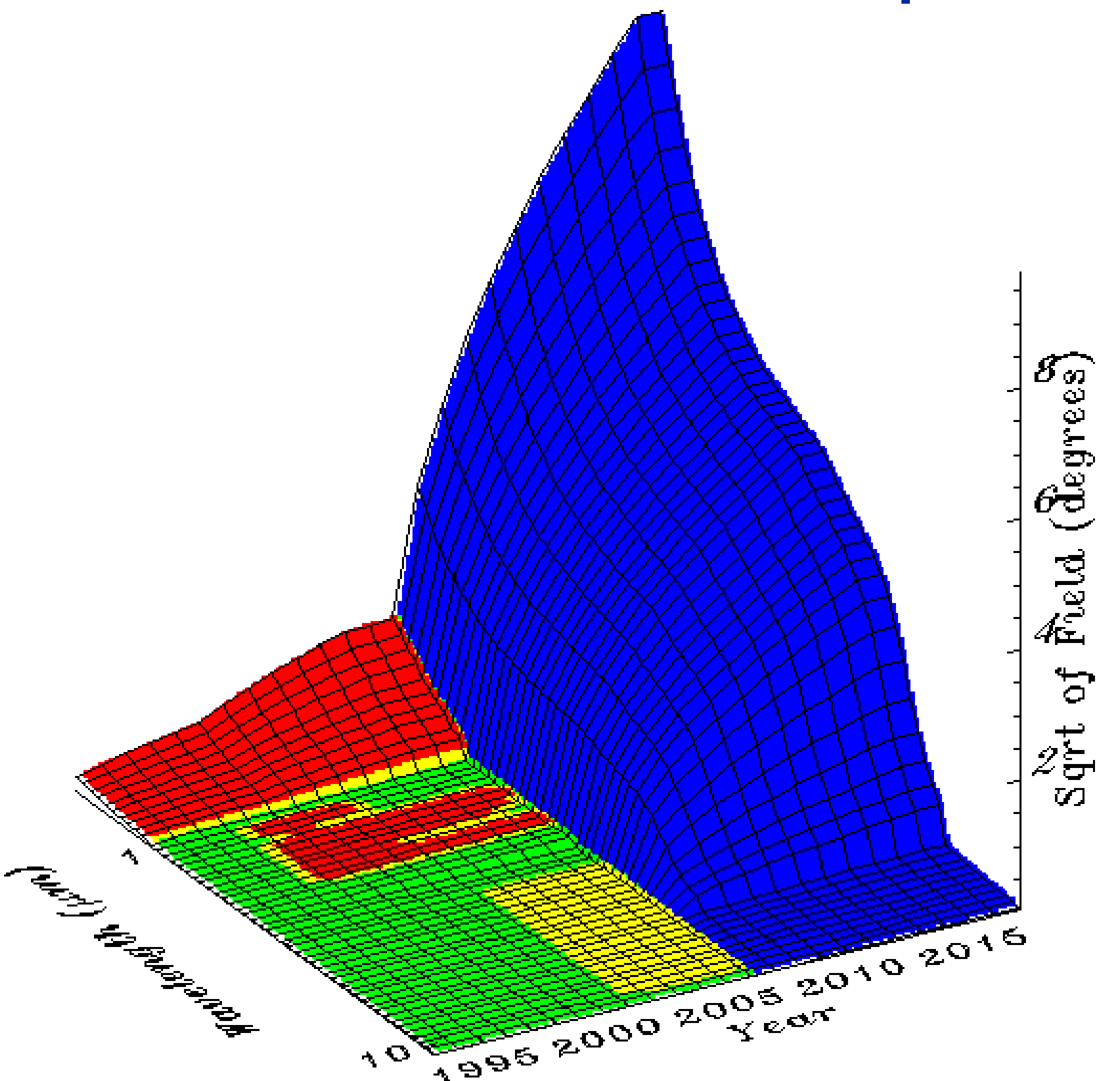


- *NGST* offers unprecedented improvements in the MIR

- Science programs would include:
  - Old-star Luminosity Function & kinematics, z = 2-5
  - High resolution TIR (10x SIRTF resolution)
  - TIR spectroscopy
    - Ne V (14.3μm)
    - Low T_e dependence of TIR lines

Science with NGST
GSFC, 7 April 1997

The Potential Impact of NGST



- Width of accumulated field covered in a single color to 1nJy level for all facilities and 8-m NGST launched in 2007.

NGST

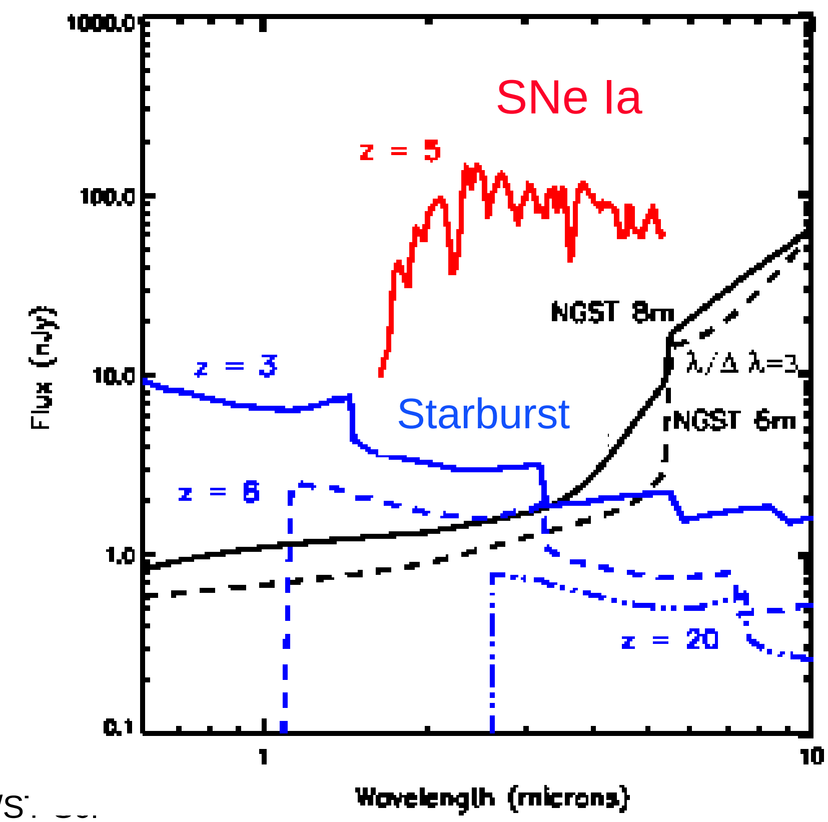
HST

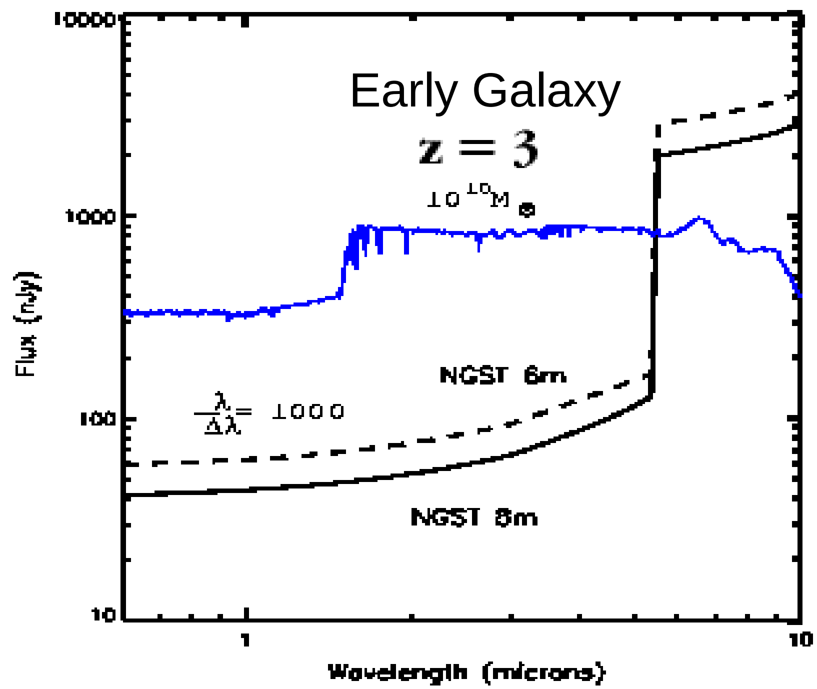
SIRTF

GROUND

Characteristic Sensitivities

Imaging





Spectroscopy